

S.N. 09/681,821

RD-26,970

## AMENDMENTS TO THE CLAIMS

Claim 1. (Currently amended) A diffusion barrier coating, comprising:

(a) about 15 atom % to about ~~95 atom %~~ 85 atom % chromium; and

(b) about 15 atom % to about 60 atom % rhenium.

Claim 2. (Original) The barrier coating material of claim 1, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 3. (Original) The barrier coating material of claim 1, further comprising about 1 atom % to about 35 atom % aluminum.

Claim 4. (Original) The barrier coating material of claim 1, wherein the level of chromium is in the range of about 25 atom % to about 60 atom %.

Claim 5. (Previously amended) The diffusion barrier coating of claim 48, wherein the level of tungsten is in the range of about 10 atom % to about 20 atom %.

Claim 6. (Currently amended) The diffusion barrier coating of claim 5, wherein the level of tungsten is in the range of about 10 atom % to about 15 atom %, ~~and the level of chromium is in the range of about 15 atom % to about 90 atom %.~~

S.N. 09/681,821

RD-26,970

Claim 7. (Original) The barrier coating of claim 5, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 8. (Original) The barrier coating material of claim 5, further comprising about 5 atom % to about 30 atom % of nickel.

Claim 9. (Original) The barrier coating material of claim 5, further comprising about 1 atom % to about 35 atom % aluminum.

Claim 10. (Original) The barrier coating material of claim 1, wherein the level of rhenium is in the range of about 15 atom % to about 35 atom %.

Claim 11. (Original) The barrier coating of claim 10, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 12. (Original) The barrier coating material of claim 10, further comprising about 1 atom % to about 35 atom % aluminum.

Claim 13. (Canceled)

Claim 14. (Currently amended) The barrier coating material of ~~claim 13~~ claim 49, wherein the level of ruthenium is in the range of about 20 atom % to about 40 atom %.

Claim 15. (Currently amended) The barrier coating material of ~~claim 13~~ claim 49, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

S.N. 09/681,821

RD-26,970

## Claims 16-17. (Canceled)

Claim 18. (Original) The barrier coating material of claim 1, wherein the level of rhenium is in the range of about 40 atom % to about 60 atom %.

Claim 19. (Original) The barrier coating material of claim 18, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 20. (Original) The barrier coating material of claim 18, further comprising about 1 atom % to about 35 atom % aluminum.

Claim 21. (Original) An article for use in a high-temperature, oxidative environment, comprising:

(i) a metal-based substrate, comprising aluminum and other alloy elements;

(ii) a diffusion barrier layer overlying the substrate, said layer comprising

(A) about 15 atom % to about 95 atom % chromium; and

(B) about 5 atom % to about 60 atom % of at least one element selected from the group consisting of rhenium, tungsten, ruthenium, and combinations thereof; and

(iii) an oxidation-resistant coating over the diffusion barrier layer.

S.N. 09/681,821

RD-26,970

Claim 22. (Original) The article of claim 21, wherein the level of chromium in the diffusion barrier layer is in the range of about 50 atom % to about 95 atom %.

Claim 23. (Original) The article of claim 21, wherein the level of chromium is in the range of about 25 atom % to about 60 atom %.

Claim 24. (Original) The article of claim 21, wherein the diffusion barrier layer further comprises about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 25. (Original) The article of claim 21, wherein the diffusion barrier layer further comprises about 1 atom % to about 35 atom % aluminum.

Claim 26. (Original) The article of claim 21, wherein the metal-based substrate is a superalloy, and comprises at least one base metal selected from the group consisting of nickel, cobalt, and iron.

Claim 27. (Currently amended) The article of claim 26, wherein the substrate further comprises at least one alloy element selected from the group consisting of ~~cobalt~~, aluminum, chromium, hafnium, yttrium, molybdenum, titanium, tantalum, carbon, and boron.

Claim 28. (Original) The article of claim 21, wherein the oxidation-resistant coating of component (iii) is an aluminum-rich coating, and the diffusion barrier layer of component (ii) prevents the substantial migration of aluminum from the aluminum-rich coating to the substrate, while also preventing the substantial migration of alloy elements of the substrate into the aluminum-rich coating.

S.N. 09/681,821

RD-26,970

**Claim 29. (Original)** The article of claim 28, wherein the aluminum-rich coating over the diffusion-barrier layer is an aluminide coating or an overlay coating.

**Claim 30. (Original)** The article of claim 29, wherein the aluminide coating is selected from the group consisting of nickel-aluminide; noble metal-aluminide, and nickel-noble metal-aluminide.

**Claim 31. (Original)** The article of claim 30, wherein the noble metal is platinum.

**Claim 32. (Original)** The article of claim 21, wherein the oxidation-resistant coating of component (iii) is an overlay coating having the composition MCrAl(X), where M is an element selected from the group consisting of Ni, Co, Fe, and combinations thereof; and X is an element selected from the group consisting of Y, Ta, Si, Hf, Ti, Zr, B, C, and combinations thereof.

**Claim 33. (Currently Amended)** The article of claim 21, wherein the oxidation-resistant coating of component (iii) comprises a ~~nickel-chrome~~ nickel-chromium alloy.

**Claim 34. (Currently Amended)** The article of claim 33, wherein the ~~nickel-chrome~~ nickel-chromium alloy contains about 20 atom % to about 50 atom % chromium, and further comprises at least one element selected from the group consisting of manganese, silicon, and a rare earth element.

**Claim 35. (Original)** The article of claim 21, wherein the barrier layer has an average thickness in the range of about 1 micron to about 50 microns.

S.N. 09/681,821

RD-26,970

Claim 36. (Original) The article of claim 35, wherein the barrier layer has an average thickness in the range of about 5 microns to about 20 microns.

Claim 37. (Original) The article of claim 21, further comprising a ceramic coating disposed over the oxidation-resistant coating of component (iii).

Claim 38. (Original) The article of claim 37, wherein the ceramic coating is a zirconia-based thermal barrier coating.

Claim 39. (Original) The article of claim 21, wherein the substrate is an airfoil of a gas turbine engine.

Claim 40. (Currently Amended) A turbine engine component for use in a high-temperature, oxidative environment, comprising:

(I) a superalloy substrate, comprising a nickel or nickel-cobalt alloy;

(II) a diffusion barrier layer overlying the substrate, said layer comprising

(a) about 15 atom % to about 95 atom % chromium;

(b) about 5 atom % to about 60 atom % of at least one element selected from the group consisting of rhenium, tungsten, ruthenium, and combinations thereof;

S.N. 09/681,821

RD-26,970

(c) about 1 atom % to about 35 atom % of at least one element selected from ~~at least one element selected from~~ the group consisting of nickel, cobalt, iron, and combinations thereof; and

(d) about 1 atom % to about 35 atom %  
aluminum,

wherein, for the maximum level of chromium present, the sum of (a), (b), (c), and (d) is no greater than 100%;

(III) an oxidation-resistant coating over the diffusion barrier layer, comprising a material selected from the group consisting of aluminide materials, MCrAl(X) materials, and ~~nickel-chrome~~ nickel-chromium materials,

where M is an element selected from the group consisting of Ni, Co, Fe, and combinations thereof; and X is an element selected from the group consisting of Y, Ta, Si, Hf, Ti, Zr, B, C, and combinations thereof; and

(IV) a zirconia-based thermal barrier coating over the oxidation-resistant coating.

#### Claims 41-47 (Withdrawn)

Claim 48. (Currently amended) A diffusion barrier coating, comprising:

(a) about 15 atom % to about ~~95~~ 90 atom %  
chromium; and

(b) about 10 atom % to about 60 atom % tungsten.

S.N. 09/681,821

RD-26,970

Claim 49. (Previously amended) A barrier coating material, comprising:

- (a) about 15 atom % to about 95 atom % chromium;
  - (b) about 10 atom % to about 60 atom % ruthenium;
- and
- (c) about 1 atom % to about 15 atom % aluminum;

wherein, for the maximum level of chromium present, the sum of (a), (b), and (c) is no greater than 100%.

Claim 50. (Currently Amended) A diffusion barrier coating, having a thickness in the range of about 1 micron to about 50 microns, and consisting essentially of:

- (a) about ~~15~~ 40 atom % to about 95 atom % chromium;

and

- (b) about 5 atom % to about 60 atom % of at least one element selected from the group consisting of rhenium, tungsten, ruthenium, and combinations thereof.

Claim 51. (Previously amended) A diffusion barrier coating, consisting essentially of:

- (a) about 15 atom % to about 95 atom % chromium;



S.N. 09/681,821

RD-26,970

(b) at least one element selected from the group consisting of rhenium, tungsten, ruthenium, and combinations thereof; wherein for each element which may be present:

the level of rhenium is from about 15 atom % to about 60 atom %;  
the level of tungsten is from about 10 atom % to about 60 atom %; and  
the level of ruthenium is from about 5 atom % to about 60 atom %; and

(c) about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof,

wherein, for the maximum level of chromium present, the sum of (a), (b), and (c) is no greater than 100%.

Claim 52. (Previously amended) A barrier coating material, consisting essentially of:

(a) about 15 atom % to about 95 atom % chromium;

(b) at least one element selected from the group consisting of rhenium, tungsten, ruthenium, and combinations thereof; wherein for each element which may be present:

the level of rhenium is from about 15 atom % to about 60 atom %;  
the level of tungsten is from about 10 atom % to about 60 atom %; and

S.N. 09/681,821

RD-26,970

the level of ruthenium is from about 5 atom % to about 60 atom %;

(c) about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof; and

(d) about 0.1 atom % to about 5 atom % of at least one element selected from the group consisting of zirconium, titanium, hafnium, silicon, boron, carbon, tantalum, molybdenum, and yttrium,

wherein, for the maximum level of chromium present, the sum of (a), (b), (c), and (d) is no greater than 100%.

Claim 53. (Previously added) The barrier coating material of claim 3, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 54. (Previously added) The barrier coating material of claim 3, further comprising at least one element selected from the group consisting of tungsten, ruthenium, and mixtures of tungsten and ruthenium.

Claim 55. (Previously added) The barrier coating material of claim 9, further comprising about 1 atom % to about 35 atom % of at least one element selected from the group consisting of nickel, cobalt, iron, and combinations thereof.

Claim 56. (Previously added) The barrier coating material of claim 9, further comprising at least one element selected from the group consisting of rhenium, ruthenium, and mixtures of rhenium and ruthenium.

S.N. 09/681,821

RD-26,970

Claim 57. (Currently amended) The barrier coating material of ~~claim~~  
~~13~~ claim 49, further comprising at least one element selected from the group  
consisting of tungsten, rhenium, and mixtures of tungsten and rhenium.